B. Aquatic Conservation Strategy

The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service and Bureau of Land Management within the range of Pacific Ocean anadromy.

This conservation strategy employs several tactics to approach the goal of maintaining the “natural” disturbance regime. Land use activities need to be limited or excluded in those parts of the watershed prone to instability. The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak streamflows. Headwater riparian areas need to be protected, so that when debris slides and flows occur they contain coarse woody debris and boulders necessary for creating habitat farther downstream. Riparian areas along larger channels need protection to limit bank erosion, ensure an adequate and continuous supply of coarse woody debris to channels, and provide shade and microclimate protection. Watersheds currently containing the best habitat or those with the greatest potential for recovery should receive increased protection and receive highest priority for restoration programs.

Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the targeted species. The Aquatic Conservation Strategy must strive to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources and restore currently degraded habitats. This approach seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds. Because it is based on natural disturbance processes, it may take decades, possibly more than a century, to accomplish all of its objectives. Some improvements in aquatic ecosystems, however, can be expected in 10 to 20 years.

The important phrases in these standards and guidelines are “meet Aquatic Conservation Strategy objectives,” “does not retard or prevent attainment of Aquatic Conservation Strategy objectives,” and “attain Aquatic Conservation Strategy objectives.” These phrases, coupled with the phrase “maintain and restore” within each of the Aquatic Conservation Strategy objectives, define the context for agency review and implementation of management activities. Complying with the Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain the existing condition or implement actions to restore conditions. The baseline from which to assess maintaining or restoring the condition is developed through a watershed analysis. Improvement relates to restoring biological and physical processes within their ranges of natural variability.

The standards and guidelines are designed to focus the review of proposed and certain existing projects to determine compatibility with the Aquatic Conservation Strategy objectives. The standards and guidelines focus on “meeting” and “not preventing attainment” of Aquatic Conservation Strategy objectives. The intent is to ensure that a decision maker must find that the proposed management activity is consistent with the Aquatic Conservation Strategy objectives. The decision maker will use the results of watershed analysis to support the finding. In order to make the finding that a project or management action “meets” or “does not prevent attainment” of the Aquatic Conservation Strategy objectives, the analysis must include a description of the existing condition, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the proposed project or management action maintains the existing condition or moves it within the range of natural variability. Management actions that do not maintain the existing condition or lead to improved conditions in the long term would not “meet” the intent of the Aquatic Conservation Strategy and thus, should not be implemented.

Aquatic Conservation Strategy Objectives

Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

Components of the Aquatic Conservation Strategy

1. **Riparian Reserves**: Lands along streams and unstable and potentially unstable areas where special standards and guidelines direct land use.

2. **Key Watersheds**: A system of large refugia comprising watersheds that are crucial to at-risk fish species and stocks and provide high quality water.

3. **Watershed Analysis**: Procedures for conducting analysis that evaluates geomorphic and ecologic processes operating in specific watersheds. This analysis should enable watershed planning that achieves Aquatic Conservation Strategy objectives. Watershed Analysis provides the basis for monitoring and restoration programs and the foundation from which Riparian Reserves can be delineated.

4. **Watershed Restoration**: A comprehensive, long-term program of watershed restoration to restore watershed health and aquatic ecosystems, including the habitats supporting fish and other aquatic and riparian-dependent organisms.

These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. Late-Successional Reserves are also an important component of the Aquatic Conservation Strategy. The standards and guidelines under which Late-Successional Reserves are managed provide increased protection for all stream types. Because these reserves possess late-successional characteristics, they offer core areas of high quality stream habitat that will act as refugia and centers from which degraded areas can be recolonized as they recover. Streams in these reserves may be particularly important for endemic or locally distributed fish species and stocks.

1. Riparian Reserves

There are an estimated 2,627,500 acres of Riparian Reserves interspersed within the matrix. (Acres for matrix listed elsewhere in these standards and guidelines do not include Riparian Reserves.) Riparian Reserves and their appurtenant standards and guidelines also apply where these reserves overlap with any other land allocations. Acres of Riparian Reserves within other land allocations is not calculated, but is estimated to encompass 40 percent (based on a sample) of those allocations. The percent of area in Riparian Reserves varies markedly among administrative units, from a high of approximately 74 percent on the Siuslaw National Forest, to a low of approximately 4 percent on the Deschutes National Forest.

Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. Standards and guidelines prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives. Riparian Reserves include those portions of a watershed directly coupled to streams and rivers, that is, the portions of a watershed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing waterbodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Riparian Reserves include areas designated in current plans and draft plan preferred alternatives as riparian management areas or streamside management zones and primary source areas for wood and sediment such as unstable and potentially unstable areas in headwater areas and along streams. Riparian Reserves occur at the margins of standing and flowing water, intermittent stream channels and ephemeral ponds, and wetlands. Riparian Reserves generally parallel the stream network but also include other areas necessary for maintaining hydrologic, geomorphic, and ecologic processes.

Under the Aquatic Conservation Strategy, Riparian Reserves are used to maintain and restore riparian structures and functions of intermittent streams, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed. The Riparian Reserves will also serve as connectivity corridors among the Late-Successional Reserves.

Interim widths for Riparian Reserves necessary to meet Aquatic Conservation Strategy objectives for different waterbodies are established based on ecologic and geomorphic factors. These widths are designed to provide a high level of fish habitat and riparian protection until watershed and site analysis can be completed. Watershed analysis will identify critical hillslope, riparian, and channel processes that must be evaluated in order to delineate Riparian Reserves that assure protection of riparian and aquatic functions. Riparian Reserves are delineated during implementation of site-specific projects based on analysis of the critical hillslope, riparian, and channel processes and features. Although Riparian Reserve boundaries may be adjusted on permanently-flowing streams, the prescribed widths are considered to approximate those necessary for attaining Aquatic Conservation Strategy objectives. Post-watershed analysis Riparian Reserve boundaries for permanently-flowing streams should approximate the boundaries prescribed in these standards and guidelines. However, post-watershed analysis Riparian Reserve boundaries for intermittent streams may be different from the existing boundaries. The reason for the difference is the high variability of hydrologic, geomorphic and ecologic processes in a watershed affecting intermittent streams. At the same time, any analysis of Riparian Reserve widths must also consider the contribution of these reserves to other, including terrestrial, species. Watershed analysis should take into account all species that were intended to be benefited by the prescribed Riparian Reserve widths. Those species include fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets, and northern spotted owls. The specific issue for spotted owls is retention of adequate habitat conditions for dispersal.

The prescribed widths of Riparian Reserves apply to all watersheds until watershed analysis is completed, a site-specific analysis is conducted and described, and the rationale for final Riparian Reserve boundaries is presented through the appropriate NEPA decision-making process.

Riparian Reserve Widths

Riparian Reserves are specified on page C-30 of these standards and guidelines for the following five categories of streams or waterbodies:

- Fish-bearing streams

- Permanently flowing nonfish-bearing streams

- Constructed ponds and reservoirs, and wetlands greater than 1 acre

- Lakes and natural ponds

- Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas

Standards and guidelines specific to Riparian Reserves begin on page C-31.

Intermittent Streams

Intermittent streams are defined as any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria.

Including intermittent streams and wetlands within Riparian Reserves is important for successful implementation of the Aquatic Conservation Strategy. Accurate identification of these features is critical to the correct implementation of the strategy and protection of the intermittent stream and wetland functions and processes. Identification of these features is difficult at times due to the lack of surface water or wet soils during dry periods. The following discussion provides guidance on steps to identify these features for inclusion within Riparian Reserves.

Fish-bearing streams are distinguished from intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams or travel routes for fish emigrating from lakes. In these instances, the standards and guidelines for fish-bearing streams would apply to those sections of the intermittent stream used by the fish.

The following discussion pertains to Riparian Reserve widths on intermittent streams and wetlands necessary to meet Aquatic Conservation Strategy objectives. Other Riparian Reserve objectives, such as providing wildlife dispersal corridors, could lead to Riparian Reserve widths different than those necessary to protect the ecological integrity of the intermittent stream or wetland. These other objectives could yield wider Riparian Reserves than those necessary to meet Aquatic Conservation Strategy objectives. There can never be instances where Riparian Reserves would be narrower than the widths necessary to meet Aquatic Conservation Strategy objectives.

The width of Riparian Reserves necessary to protect the ecological integrity of intermittent streams varies with slope and rock type. Figure B-1 shows the estimated size of Riparian Reserves necessary to protect the ecological values of intermittent streams with different slope and rock types. These estimates were made by geomorphologists, hydrologists, and fish biologists from the Bureau of Land Management, Forest Service, and the Environmental Protection Agency. These distances are consistent with the height of one site-potential tree used to define Riparian Reserve widths (see page C-30 of these standards and guidelines).

Watershed analysis provides the ecological and geomorphic basis for changing the size and location of Riparian Reserves.

The prescribed widths for Riparian Reserves apply to all streams, lakes, ponds and wetlands on lands administered by the Forest Service and BLM within the range of the northern spotted owl until a watershed analysis is completed. Watershed analysis is expected to yield the contextual information needed to define ecologically and geomorphically appropriate Riparian Reserves. Analysis of site-specific characteristics may warrant Riparian Reserves that are narrower or wider than the prescribed widths. Thus, it is possible to meet the objectives of at least the Aquatic Conservation Strategy portion of these standards and guidelines with post-watershed analysis reserve boundaries for intermittent streams that are quite different from those conforming to the prescribed widths. Regardless of stream type, changes to Riparian Reserves must be based on scientifically sound reasoning, and be fully justified and documented.

Wetlands

The combinations of hydrology, soils, and vegetative characteristics are the primary factors influencing the development of wetland habitats. There must be the presence of surface water or saturated soils to significantly reduce the oxygen content in the soils to zero or near zero concentrations. These low or zero soil oxygen conditions must persist for sufficient duration to promote development of plant communities that have a dominance of species adapted to survive and grow under zero oxygen conditions. These wetland characteristics apply when defining wetlands for regulatory jurisdiction or for technical analysis when conducting inventories or functional assessments. Seeps and springs can be classified as streams if they have sufficient flow in a channel or as seasonal or perennial wetlands under the criteria defined in the 1987 Corps of Engineers Wetlands Manual. The standards and guidelines for wetlands, which are based on the hydrologic, physical and biologic characteristics described in the manual, apply to seeps and springs regardless of their size.

Formal definition for implementing section 404 of the Clean Water Act, adopted by the Environmental Protection Agency, is as follows:

> The term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Detailed technical methods have been developed to assist in identification of wetlands that meet the above definition. Currently, the field manual being used for implementing the Clean Water Act is the “1987 Corps Manual.”

For purposes of conducting the National Wetland Inventory, the Fish and Wildlife Service has broadly defined both vegetated and nonvegetated wetlands as follows:

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained

hydric soil, and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Wetlands typically occur within and adjacent to riparian zones. It is frequently difficult to differentiate wetlands from riparian areas based on the definitions. Most typically, and particularly in forested landscapes, the riparian zone is defined by its spatial relation to adjacent streams or rivers. However, riparian zones are also commonly considered to be lands integrally related to other aquatic habitats such as lakes, reservoirs, intermittent streams, springs, seeps, and wetlands.

Because of such conceptual and definitional vagaries, there is spatial overlap between wetlands and riparian zones. This then results in only a portion of the riparian zone associated with rivers and streams being considered as wetlands. The extent of that portion will depend on the specifics of hydrologic, vegetation, and soil features. The functions of the wetland portion may also be distinct from the nonwetlands. For example, wetlands may provide habitat for specialized plant species or reproductive habitat for amphibians or other organisms that would not be provided by riparian areas.

Once the Riparian Reserve width is established, either based on existing widths or watershed analysis, then land management activities allowed in the Riparian Reserve will be directed by standards and guidelines for managing Riparian Reserves (see page C-31). The standards and guidelines for Riparian Reserves prohibit or regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives.

Summary of Aquatic Conservation Strategy for Riparian Reserves:

- Involves portions of the landscape where riparian-dependent and stream resources receive primary emphasis.

- Riparian Reserves are designated for all permanently-flowing streams, lakes, wetlands, and intermittent streams.

- Riparian Reserves include the body of water, inner gorges, all riparian vegetation, 100-year floodplain, landslides and landslide prone areas.

- Reserve widths are based on some multiple of a site-potential tree or a prescribed slope distance, whichever is greater. Reserve widths may be adjusted based on watershed analysis to meet Aquatic Conservation Strategy objectives.

- Standards and guidelines prohibit programmed timber harvest, and manage roads, grazing, mining and recreation to achieve objectives of the Aquatic Conservation Strategy (see page C-31).

2. Key Watersheds

There are 8,119,400 acres of Tier 1 Key Watersheds, and 1,001,700 acres of Tier 2 Key Watersheds within the range of the northern spotted owl. Key Watersheds overlay the land allocations of designated areas and matrix as follows:

Acres in each designated area and matrix, by Key and non-Key Watersheds.

	Tier 1	Tier 2	non-Key	Total
Designated Areas				
Congressionally Reserved Areas	2,728,000	311,200	4,281,400	7,320,600
Late-Successional Reserves	3,151,700	279,100	4,000,000	7,430,800
Adaptive Management Areas	228,100	60,600	1,233,100	1,521,800
Managed Late-Successional Areas	55,100	0	47,100	102,200
Administratively Withdrawn Areas	407,900	54,700	1,014,500	1,477,100
Riparian Reserves (based on sample)	631,000	113,700	1,882,800	2,627,500
Matrix				
Matrix	917,600	182,400	2,875,300	3,975,300
Total	8,119,400	1,001,700	15,334,200	24,455,300

Refugia are a cornerstone of most species conservation strategies. They are designated areas that either provide, or are expected to provide, high quality habitat. A system of Key Watersheds that serve as refugia is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. These refugia include areas of high quality habitat as well as areas of degraded habitat. Key Watersheds with high quality conditions will serve as anchors for the potential recovery of depressed stocks. Those of lower quality habitat have a high potential for restoration and will become future sources of high quality habitat with the implementation of a comprehensive restoration program (see Watershed Restoration later in this section of these standards and guidelines).

The Aquatic Conservation Strategy includes two designations for Key Watersheds. Tier 1 (Aquatic Conservation Emphasis) Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also have a high potential of being restored as part of a watershed restoration program. Tier 1 Key Watersheds consist primarily of watersheds identified previously by the Scientific Panel on Late-Successional Forest Ecosystems (1991), and in the Scientific Analysis Team Report (1993). The network of 143 Tier 1 Key Watersheds ensures that refugia are widely distributed across the landscape. While 21 Tier 2 (other) Key Watersheds may not contain at-risk fish stocks, they are important sources of high quality water.

Long-term management within Key Watersheds requires watershed analysis prior to further resource management activity. In the short term, until watershed analysis can be completed, minor activities such as those that would be Categorically Excluded under National Environmental Policy Act regulations (except timber harvest) may proceed if they are consistent with Aquatic Conservation Strategy objectives and apply Riparian Reserves and standards and guidelines. Timber harvest, including salvage, can not occur in Key Watersheds without a watershed analysis. Key Watersheds that currently contain poor quality habitat are believed to have the best opportunity for successful restoration and will receive priority in any watershed restoration program.

Roadless Areas and Key Watersheds

Management activities in inventoried roadless areas with unstable land will increase the risk to aquatic and riparian habitat, impair the capacity of Key Watersheds to function as intended, and limit the potential to achieve Aquatic Conservation Strategy objectives. Standards and guidelines that refer to inventoried roadless areas (or simply “roadless areas”) apply only to those portions of such areas that would still qualify as roadless under the guidelines used to originally designate the areas under the second Forest Service Roadless Area Review and Evaluation (RARE II).

To protect the remaining high quality habitats, no new roads will be constructed in inventoried roadless areas in Key Watersheds. Watershed analysis must be conducted in all non-Key Watersheds that contain roadless areas before any management activities can occur within those roadless areas.

The amount of existing system and nonsystem roads within Key Watersheds should be reduced through decommissioning of roads. Road closures with gates or barriers do not qualify as decommissioning or a reduction in road mileage. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds. That is, for each mile of new road constructed, at least one mile of road should be decommissioned, and priority given to roads that pose the greatest risks to riparian and aquatic ecosystems.

Summary of Aquatic Conservation Strategy for Key Watersheds:

- Tier 1 Key Watersheds were selected for directly contributing to anadromous salmonid and bull trout conservation.

- Tier 2 Key Watersheds were selected as sources of high quality water and may not contain at-risk fish stocks

- No new roads will be built in roadless areas in Key Watersheds.

- Reduce existing system and nonsystem road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds.

- Key Watersheds are highest priority for watershed restoration.

- Watershed analysis is required prior to management activities, except minor activities such as those Categorically Excluded under NEPA (and not including timber harvest).

- Timber harvest cannot occur in Key Watersheds prior to completing a watershed analysis.

Standards and guidelines specific to Key Watersheds are summarized on page C-7 of these standards and guidelines.

3. Watershed Analysis

Watershed analysis, as described here, focuses on implementing the Aquatic Conservation Strategy. The broader role of watershed analysis in relation to implementing the ecosystem management objectives proposed by these standards and guidelines is described in Section E, Implementation. Watershed analysis is one of the principal analyses that will be used in making decisions on implementation of the Aquatic Conservation Strategy.

Watershed analysis is required in Key Watersheds, for roadless areas in non-Key Watersheds, and Riparian Reserves prior to determining how proposed land management activities meet Aquatic Conservation Strategy objectives. Watershed analyses must be completed before initiating actions within a Key Watershed, except that in the short term, until watershed analysis can be completed, minor activities such as those that would be categorically excluded under National Environmental Policy Act regulations (except timber harvest) may proceed if they are consistent with Aquatic Conservation Strategy objectives and Riparian Reserves and standards and guidelines are applied. Timber harvest, including salvage, cannot occur in Key Watersheds without a watershed analysis. Ultimately, watershed analyses should be conducted in all watersheds on federal lands as a basis for ecosystem planning and management.

Watershed analysis has a critical role in providing for aquatic and riparian habitat protection. In planning for ecosystem management and establishing Riparian Reserves to protect and restore riparian and aquatic habitat, the overall watershed condition and the array of processes operating there need to be considered. Watershed condition includes more than just the state of the channel and riparian area. It also includes the condition of the uplands, distribution and type of seral classes of vegetation, land use history, effects of previous natural and land-use related disturbances, and distribution and abundance of species and populations throughout the watershed. These factors strongly influence the structure and functioning of aquatic and riparian habitat. Effective protection strategies for riparian and aquatic habitat on federal lands must accommodate the wide variability in landscape conditions present across the Pacific Northwest. Watershed analysis plays a key role in the Aquatic Conservation Strategy, ensuring that aquatic system protection is fitted to specific landscapes.

Watershed analysis will focus on collecting and compiling information within the watershed that is essential for making sound management decisions. It will be an analytical process, not a decision-making process with a proposed action requiring NEPA documentation. It will serve as the basis for developing project-specific proposals, and monitoring and restoration needs for a watershed. Some analysis of issues or resources may be included in broader scale analyses because of their scope. The information from the watershed analyses will contribute to decision making at all levels. Project-specific NEPA planning will use information developed from watershed analysis. For example, if watershed analysis shows that restoring certain resources within a watershed could contribute to achieving landscape or ecosystem management objectives, then subsequent decisions will need to address that information.

The results of watershed analyses may include a description of the resource needs, capabilities, opportunities, the range of natural variability, spatially explicit information that will facilitate environmental and cumulative effects analyses for NEPA, and the processes and functions operating within the watershed. Watershed analysis will identify potentially disjunct approaches and conflicting objectives within watersheds. The information from watershed analysis will be used to develop priorities for funding, and implementing actions and projects, and will be used in developing monitoring strategies and objectives. The participation of adjacent landowners, private citizens, interest groups, industry, various government agencies, and others in watershed analyses will be promoted.

Watershed analysis is a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. This information will support decisions for implementing management prescriptions, including setting and refining boundaries of Riparian Reserves and other reserves, developing restoration strategies and priorities, and revealing the most useful indicators for monitoring environmental changes. Watershed analysis is an important analytical step supporting ecosystem planning for watersheds of approximately 20 to 200 square miles (Figure B-2). It is a key component supporting watershed planning and analyzing the blending of social expectations with the biophysical capabilities of specific landscapes. Watershed analysis is the appropriate level for analyzing the effects of transportation systems on aquatic and riparian habitats within the target watershed. In contrast, issues pertaining to stocks at risk would generally be more applicable at the province or river basin analytical levels, as discussed in Section E of these standards and guidelines, rather than the 20 to 200 square mile watershed level.

Watershed analysis consists of technically rigorous and defensible procedures designed to identify processes that are active within a watershed, how those processes are distributed in time and space, the current upland and riparian conditions of the watershed, and how all of these factors influence riparian habitat and other beneficial uses. The analysis is conducted by an interdisciplinary team consisting of geomorphologists, hydrologists, soil scientists, biologists and other specialists as needed. Information used in this analysis includes: maps of topography, stream networks, soils, vegetation, and geology; sequential aerial photographs; field inventories and surveys including landslide, channel, aquatic habitat, and riparian condition inventories; census data on species presence and abundance; water quality data; disturbance and land use history; and other historical data (e.g., streamflow records, old channel surveys).

Watershed analysis is organized as a set of modules that examine biotic and abiotic processes influencing aquatic habitat and species abundance (e.g., landslides, surface erosion, peak and low streamflows, stream temperatures, road network effects, coarse woody debris dynamics, channel processes, fire, limiting factor analysis for key species). Results from these modules are integrated into a description of current upland, riparian, and channel conditions; maps of location, frequency, and magnitude of key processes; and descriptions of location and abundance of key species.

Watershed analysis provides the contextual basis at the site level for decision makers to set appropriate boundaries of Riparian Reserves, plan land use activities compatible with disturbance patterns, design road transportation networks that pose minimal risk, identify what and where restoration activities will be most effective, and establish specific parameters and activities to be monitored. More detailed site-level analysis is conducted to provide the information and designs needed for specific projects (e.g., road siting or timber sale layout) so that riparian and aquatic habitats are protected.

Watershed analysis provides the ecologic and geomorphic basis for changing the size and location of Riparian Reserves necessary to meet Aquatic Conservation Strategy objectives. Ultimate design of Riparian Reserves is likely to be a hybrid of decisions based on consideration of sites of special ecological value, slope stability, wildlife dispersal corridors, endemic species considerations and natural disturbance processes.

Figure B-3 illustrates how slope stability and debris flow runout models may be used as part of watershed analysis for adjusting Riparian Reserves. The result is that the basin is stratified into areas that may require wider or narrower Riparian Reserves than those conforming to Riparian Reserve Scenario 1 for intermittent streams. For example, on intermittent streams in unstable areas with high potential to generate slides and debris flows, Riparian Reserves wider than those conforming to the definition may be necessary to ensure ecological integrity. Riparian Reserves in more stable areas may be less extensive, managed under upland standards and guidelines (e.g., levels of green-tree retention as either single trees or in patches of a specific size), or a combination of these.

Slope stability analysis for Augusta Creek is an example in which likely impact mechanisms are identified (Figure B-4). Distribution of areas subject to slope instability was interpreted from information contained within the Willamette National Forest Soil Resource Inventory. Slope data for each mapped unit was extracted from the Willamette National Forest Soil Resource Inventory based on whether hillslope gradients were less than 30 percent, between 30 and 60 percent, and greater than 60 percent. Geologic descriptions from the Willamette National Forest Soil Resource Inventory were used to determine whether underlying bedrock was hard, moderately hard, or soft. A hazard rating of low, moderate, or high slide potential was assigned to each mapped unit based on hillslope gradient and geologic description (Figure B-4). Predicted hazard ratings were tested and found to be in excellent agreement with the historical pattern of landslides observed on aerial photographs. This analytical step ensures that field and analysis time will be used efficiently to address the most important processes and issues in the watershed.

Using the results from the slope stability analysis, watersheds were stratified into subareas in order to evaluate the watersheds as uniform response units for each of the processes or issues of concern. The process of determining debris flow susceptibility for Augusta Creek is an example of how a watershed might be stratified and how this stratification may be used as a basis for mapping Riparian Reserves (Figure B-3). To determine the susceptibility of different stream reaches to debris flows, a stream network map was overlaid on the slide potential map (Figure B-4). Areas with high slope instability were assumed to be most likely to generate debris flows. First-order channels (headward channels without tributaries) were assigned a debris flow hazard rating equal to the slide potential of the surrounding landscape (Figure B-4). Debris flow hazard to higher order channels downstream was assumed to be a function of two factors: channel gradient (Figure B-5) and tributary junction angle (Figure B-6). Debris flow hazard was reduced on the class where channel gradient was less than 3 degrees or tributary junction angle exceeded 70 degrees, to produce a map of debris flow potential (Figure B-7). The stratification will vary according to process or issue.

Within a given physiographic province, similar geographic and topographic features control drainage network and hillslope stability patterns. These features may exert a strong influence on the design of Riparian Reserves. For example, in the highly dissected southern Oregon Coast Range, debris flows originating in channel heads are the primary mass movement process. Large, slow-moving earthflows are dominant in the western Oregon Cascades. Earthflows qualify as unstable and potentially unstable areas and would be analyzed for inclusion within Riparian Reserves for intermittent streams. To adequately protect the aquatic system from management induced landsliding, Riparian Reserve design may vary as a result of these differences. In the Coast Range, Riparian Reserves would tend to be in narrow bands associated with intermittent streams, relatively evenly distributed throughout the basin, while those in the

Cascades may be locally extensive and centered around earthflows. Stable areas in other parts of the watershed may have reduced Riparian Reserves on intermittent streams.

Earthflows can cover extensive amounts of land within a watershed. As such, they largely influence the resulting landscape and directly affect aquatic and riparian habitat quality, structure and function. For example, streams flowing through active earthflows would tend to cut the toes of the inner gorges. Thus, the earthflow would serve as a chronic source of sediment to the channel. The effects of constructing roads or harvesting timber on the rate of sediment delivery to the channel on the earthflow would need to be considered during the design of the Riparian Reserve. Thus, the amount of a particular earthflow incorporated into a Riparian Reserve, as identified through watershed analysis, depends on the risk of management-induced disturbances and meeting Aquatic Conservation Strategy objectives. The risk will be determined based on an analysis of the projected instability of the earthflow relative to the recovery rate of aquatic and riparian ecosystems. There will be cases where entire earthflows will be incorporated into Riparian Reserves and cases where only those portions determined to directly affect the rate of achieving Aquatic Conservation Strategy objectives will be incorporated.

The efficacy of many previous analyses at the watershed level suffered from unclear logic used in weighting or combining individual elements, reliance on simple indices to explain complex phenomena, and assumptions of direct or linear relations between land use intensity and watershed response. These previous watershed analyses typically did not consider how key processes are distributed over watersheds within a given landscape and, in many cases, did not distinguish between physiographic provinces, which can vary widely in the importance of individual processes. Furthermore, most of the previous approaches lacked any method to validate their assumptions or results.

While watershed analysis can provide essential information for designing land use activities over the entire watershed, it can also highlight uncertainties in knowledge or understanding that need to be addressed. Watershed analysis is emerging as a new standard for assessing watershed condition and land use impacts. The process described in these standards and guidelines builds on more recent, comprehensive approaches, including the Water Resources Evaluation of Nonpoint Silvicultural Sources program; the watershed analysis procedure developed by the Washington State Timber, Fish and Wildlife program; and the cumulative effects methods being developed by the National Council on Air and Stream Improvement. Analysis modules in Watershed Analysis are patterned after the first two approaches because a modular approach allows flexibility in selecting methods appropriate to a particular watershed and facilitates modification of specific techniques as improved methods become available. Unique aspects of the watershed analysis procedure described in the FEMAT Report include explicit consideration of biological as well as physical processes, and the joint consideration of upland and riparian areas.

Watershed analysis is one of the important aspects of effectively implementing ecosystem planning and management on a watershed basis. Information gained through watershed analysis will be vital to adaptive management over broad physiographic provinces. When current plans and draft plan preferred alternatives are revised, information gathered through watershed analysis will, in part, be the basis of these revisions.

Summary of Aquatic Conservation Strategy for Watershed Analysis:

- Watershed analysis is a systematic procedure to characterize watersheds. The information is used to guide management prescription and monitoring programs, set and refine Riparian Reserve boundaries, and develop restoration.

- It is required in Key Watersheds prior to resource management.
- It is required in all roadless areas prior to resource management.
- It is recommended in all other watersheds.
- It is required to change Riparian Reserve widths in all watersheds.
- Earthflows qualify as unstable and potentially unstable areas and would be analyzed for inclusion within Riparian Reserves.
- Watershed analysis is important in developing monitoring strategies.

4. Watershed Restoration

Watershed restoration will be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality. Restoration will be based on watershed analysis and planning. Watershed analysis is essential to identify areas of greatest benefit-to-cost relationships for restoration opportunities and greatest likelihood of success. Watershed analysis can also be used as a medium to develop cooperative projects involving various landowners. In many watersheds the most critical restoration needs occur on private lands downstream from federally managed lands. Decisions to apply a given treatment depend on the value and sensitivity of downstream uses, transportation needs, social expectations, risk assessment of probable outcomes for success at correcting problems, costs, and other factors. Watershed analysis, including the use of sediment budgets, provides a framework for considering benefit-to-cost relations in a watershed context. Thus, the magnitude of restoration needs within the planning area will be based on watershed analysis.

The most important components of a watershed restoration program are control and prevention of road-related runoff and sediment production, restoration of the condition of riparian vegetation, and restoration of in-stream habitat complexity. Other restoration opportunities exist, such as meadow and wetland restoration and mine reclamation, and these may be quite important in some areas. Regionally however, these opportunities are much less extensive than the three components listed above.

Roads

Road treatments range from full decommissioning (closing and stabilizing a road to eliminate potential for storm damage and the need for maintenance) to simple road upgrading, which leaves the road open. Upgrading can involve practices such as removing soil from locations where there is a high potential of triggering landslides, modifying road drainage systems to reduce the extent to which the road functions as an extension of the stream network, and reconstructing stream crossings to reduce the risk and consequences of road failure or washing out at the crossings.

The decision to apply a given treatment depends on the value and sensitivity of downstream uses, transportation needs, social expectations, assessment of probable outcomes for success at correcting problems, costs, and other factors. Watershed analysis, including the use of sediment budgets, provides a framework for considering benefit-to-cost relations in a watershed context. Thus, the magnitude of regional restoration needs will be based on watershed analysis.

Riparian Vegetation

Active silvicultural programs will be necessary to restore large conifers in Riparian Reserves. Appropriate practices may include planting unstable areas such as landslides along streams and flood terraces, thinning densely-stocked young stands to encourage development of large conifers, releasing young conifers from overtopping hardwoods, and reforesting shrub and hardwood-dominated stands with conifers. These practices can be implemented along with silvicultural treatments in uplands areas, although the practices will differ in objective and, consequently, design.

In-Stream Habitat Structures

In-stream restoration, based on the interpretation of physical and biological processes and deficiencies during watershed analysis, can be an important component of an overall program for restoring fish and riparian habitat. In-stream restoration measures are inherently short term and must be accompanied by riparian and upslope restoration to achieve long-term watershed restoration. Maintaining desired levels of channel habitat complexity, for example, may best be achieved in the short term by introducing structures. However, a riparian area with the complete array of functions and processes should provide coarse woody debris to the channel in the long term.

In-stream restoration will be accompanied by riparian and upslope restoration if watershed restoration is to be successful. In-stream restoration, including in-channel structures, will not be used to mitigate for management actions that degrade existing habitat, as a substitute for habitat protection, or to justify risky land management activities and practices. Priority must be given to protecting existing high quality habitat.

Summary of Aquatic Conservation Strategy for Watershed Restoration:

- Watershed restoration restores watershed processes to recover degraded habitat.
- Watershed restoration should focus on removing and upgrading roads.
- Silvicultural treatments may be used to restore large conifers in Riparian Reserves.
- Watershed restoration should restore channel complexity. In-stream structures should only be used in the short term and not as a mitigation for poor land management practices.

Monitoring

The following monitoring section is specific to achieving the stated objectives of the Aquatic Conservation Strategy. Implementation, effectiveness, and validation monitoring need to be conducted consistent with the monitoring discussion in Section E of these standards and guidelines.

Watershed analysis will support decisions for a variety of planned ecosystem management actions within watersheds. Specific actions may include habitat restoration, sediment reduction programs, road removal and management, timber harvesting, development of a recreation facility, or any of a multitude of activities. Monitoring will be an essential component of these management actions and will be guided by the results of watershed analysis.

General objectives of monitoring will be to: (1) determine if Best Management Practices have been implemented, (2) determine the effectiveness of management practices at multiple scales, ranging from individual sites to watersheds, and (3) validate whether ecosystem functions and processes have been maintained as predicted. In addition, monitoring will provide feedback to fuel the adaptive management process.

Specific monitoring objectives will be derived from results of the watershed analysis and tailored to each watershed. Monitoring at the 20 to 200 square mile watershed level will link monitoring for ecosystem management objectives for multiple scales of province, river basin, smaller watershed and site-specific levels. Specific locations of unstable and potentially unstable areas, roads, and harvest activities will be identified. In addition, the spatial relationship of potentially unstable areas and management actions to sensitive habitats such as wetlands will be determined. This information provides a basis for targeting watershed monitoring activities to assess outcomes associated with risks and uncertainties identified during watershed analyses.

Under natural conditions, river and stream habitats on federal forest lands exhibit an extremely wide diversity of conditions depending on past disturbances, topography, geomorphology, climate and other factors. Consequently, riparian area monitoring must be dispersed among the various landscapes rather than concentrated at a few sites and then extrapolated to the entire forest. Logistical and financial constraints require a stratified monitoring program that includes:

- Post-project site review
- Reference to subdrainages
- Basin monitoring
- A water quality network
- Landscape integration of monitoring data

A stratified monitoring program examines watersheds at several spatial and temporal scales. Information is provided on hillslope, floodplain, and channel functions, water quality, fish and wildlife habitat and populations, and vegetation diversity and dynamics.

Parameters selected for monitoring depend on the activities planned for a given watershed designed to specifically address forest practices and associated activities such as road construction and maintenance. Two of the more extensive activities related to water quality are timber harvest and road related operations. Other activities such as mining and in-stream channel alterations to improve habitat can affect water quality in localized areas. In addition to chemical and physical parameters, biological criteria may be appropriate to monitor using techniques such as Rapid Bioassessment Protocols for macroinvertebrates or the index of biotic integrity for fish diversity.

Long-term systematic monitoring in selected watersheds will be necessary to provide reference points for effectiveness and validation monitoring. These watersheds should represent a range of forest and stream conditions that have been exposed to natural and induced disturbance. Reference watersheds, subbasins, and individual sites will be selected as part of the overall adaptive management process described as part of these standards and guidelines.

Study plans will be cooperatively developed based on province, river basin, and/or watershed level analyses. Long-term data sets from reference watersheds will provide an essential basis for adaptive management and a gauge by which to assess trends in in-stream condition.

Monitoring plans must be tailored for each watershed. Significant differences in type and intensity of monitoring will occur based on watershed characteristics and management actions. For example, carefully targeted restoration activities may only require effectiveness monitoring of single activities, whereas watershed-scale restoration would be accompanied by extensive riparian and in-stream monitoring. The specific design of monitoring programs can best be accomplished by the local interdisciplinary teams working in cooperation with state programs. Pooling the monitoring resources of federal and state agencies is a necessity to provide interagency consistency and to increase available resources.

Monitoring will be conducted and results will be documented, analyzed and reported by the agency or agencies responsible for land management in any particular watershed. Reports will be reviewed by local interdisciplinary teams. In addition, water resource regulatory agencies may review results to determine compliance with appropriate standards, and province and river basin-level strategies. A cross-section of team members that includes participants from states and regulatory agencies should assess monitoring results and recommend changes in Best Management Practices or the mechanisms for Best Management Practice implementation.